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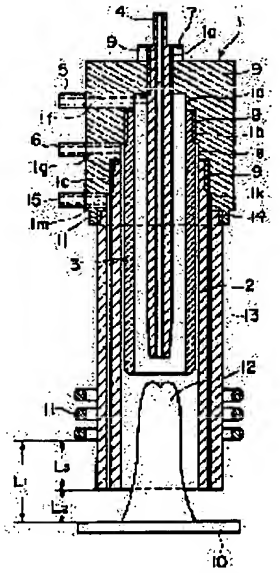
(54) INDUCTION PLASMA TORCH

(57)Abstract:
PURPOSE: To execute homogeneous thermal spraying without external influence by generating horizontally balanced plasma flame in melting and thermally spraying powder on an induction plasma torch.
CONSTITUTION: A carrier gas introduction tube 4 made of a boron nitride sintered body, an intermediate tube 3, an outer tube 2, and a cooling tube 13 are successively and concentrically engaged with and threadably attached to a cylindrical support 1 in which multistage-concentrical inserting holes 1a-1e, and 1j, 1k made by a boron nitride sintered body as a raw material are formed in the cylindrical support.



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* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]
[Claim 1] a boron-nitride sintered compact -- becoming -- the interior -- multi-stage concentric circle-like insertion -- the induction plasma torch of four layer structures characterized [a base material] by carrying out fitting screwing of the gas supply pipe which introduces gas to this pipe at a tangential direction at the nose of cam of the middle pipe in the aforementioned base material, an outside pipe, and a cooling pipe while making the cylinder-like base material in which the hole was formed carry out fitting screwing of the carrier gas introduction pipe, the middle pipe, outside pipe, and cooling pipe made from a boron-nitride sintered compact one by one
[Claim 2] The induction plasma torch of four layer structures according to claim 1 to which the position of the soffit of an outside pipe and a cooling pipe is characterized by being separated from the soffit of the induction coil prepared in the periphery of a cooling pipe 20mm or more.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] Within inductive-coupling type plasma, this invention heats fine particles, such as a ceramic metallurgy group, efficiently, can be dissolved and injected, and relates to the induction plasma torch used mainly for thermal spraying.
[0002]
[Description of the Prior Art] Conventionally, many things which prepared the water-cooled induction coil are used for the torch of the Mie structure which consists of the outside pipe formed with the transparent quartz, a middle pipe, and a carrier gas introduction pipe as an induction plasma torch. In order to make the melting coat it can be satisfied [with a thermal-spraying-ed lifter] of a coat using an induction plasma torch form originally, it is required to carry out perfect melting of the fine particles which right and left are made to generate plasma flame with sufficient balance completely, and are supplied, and it is required for that to form each aforementioned pipe in the shape of a concentric circle completely in the composition of a torch.
[0003] However, it is made very difficult to constitute a concentric circle-like torch completely using each pipe of the outside pipe made from a quartz, a middle pipe, and a carrier gas introduction pipe.
[0004] This invention persons proposed the concentric circle-like induction plasma torch to the completeness using the sintered compact of a boron nitride as a material previously in view of such a situation. namely, a boron-nitride sintered compact -- becoming -- the interior -- multi-stage concentric circle-like insertion -- it is the induction plasma torch of the structure which carried out fitting screwing of the gas supply pipe which introduces gas at the nose of cam of the middle pipe in the aforementioned base material, and an outside pipe to this pipe at a tangential direction at it while making the cylinder-like base material in which the hole was formed carry out fitting screwing of the carrier gas introduction pipe, middle pipe, and outside pipe made from a boron-nitride sintered compact one by one
[0005] When drawing of longitudinal section of drawing 2 explains the composition of this torch, in drawing, 1 is the cylindrical shape-like base material which processed and obtained the boron-nitride sintered compact. the interior of this base material 1 -- multi-stage insertion of 1a-1e -- a hole -- a base material 1 -- an engine lathe etc. -- a hole -- it prepares in the shape of a concentric circle by repeating processing and a screw cutter -- having -- **** -- these insertion -- the carrier gas introduction pipe 4, the middle pipe 3, and the outside pipe 2 are being fixed to the hole by fitting screwing
[0006] the insertion to this cylinder-like base material 1 -- the insertion for formation of a hole carrying out penetration insertion of the carrier gas introduction pipe 4 first -- a hole -- 1a -- a base material 1 -- penetration formation -- carrying out -- a degree -- insertion of the middle pipe 3 -- a hole -- 1b -- the almost middle position of a base material 1 -- insertion -- a hole -- the shape of 1a and a concentric circle -- forming -- after that -- insertion of the outside pipe 2 -- a hole -- 1c is formed subsequently, the insertion for middle pipe 3 support -- a hole -- or it is the same as the bore of the middle pipe 3 above 1b -- or insertion of a some minor diameter -- 1d of holes -- moreover, the insertion for outside pipe 2 support -- a hole -- or it is the same as the bore of the outside pipe 2 above 1c -- or insertion of a some minor diameter -- a hole -- 1e is formed
[0007] thus -- for attaching the outside pipe 2 similarly made in the shape of a cylindrical shape using the boron-nitride sintered compact, respectively to the cylinder-like base material 1 made from a boron-nitride sintered compact in which concentric circle-like 1a-1e were formed inside, the middle pipe 3, the carrier gas introduction pipe 4 and the plasma-gas supply pipe 5, and the sheath gas supply pipe 6 -- first -- insertion -- a hole -- 1a is made to penetrate the carrier gas introduction pipe 4 from a lower part, and screwing fixation is carried out with a screw 9 after that -- the same -- carrying out -- insertion -- a hole -- 1b -- the middle pipe 3 -- insertion -- a hole -- 1c -- the outside pipe 2 -- one by one -- screwing on -- subsequently -- the plasma-gas supply pipe 5 and the sheath gas introduction pipe 6 -- respectively -- insertion -- it inserts in the screw sections 1f and 1g prepared in the tangential direction, and screws on Holes 1d and 1e In addition, in order that the speed of the gas to supply may be gathered between the inner skin of the outside pipe 2, and the peripheral face of the middle pipe 3 and it may raise cooling efficiency, it serves as about 1mm small gap.
[0008] Thus, the induction plasma torch constituted in the shape of a concentric circle using the boron-nitride sintered compact is used. Plasma gas, such as argon gas, is supplied by part for 5l./between the carrier gas introduction pipe 4 and the middle pipe 3 from the plasma-gas supply pipe 5. Sheath gas, such as argon gas, is supplied by part for 20l./between the middle pipe 3 and the outside pipe 2 from the sheath gas supply way 6. If a RF (5kW and 13.56MHz) is impressed to an induction coil 11 in the state of supplying fine particles with a particle size of 5-100 micrometers by 1g/with carrier gas from the carrier gas introduction pipe 4 The normal plasma flame 12 which maintained balance well right and left occurs, melting of the fine particles is carried out, and a coat is formed on the thermal-spraying-ed object 10.

[0009]
[Problem(s) to be Solved by the Invention] However, though the induction plasma torch completely manufactured in concentric circle-like structure in this way, using a boron-nitride sintered compact as a material performs thermal spraying of melting fine particles Distance L3 from the soffit of an induction coil 11 to the soffit of the outside pipe 2 When not much short, at the time of melting by the plasma flame of fine particles, and thermal spraying, cooling solidification and oxidation reaction with the low-temperature air from the plasma-torch outside arise, and there is a possibility of producing poor thermal spraying over the thermal-spraying-ed object 10.
[0010] Moreover, distance L1 from the soffit of an induction coil 11 to the thermal-spraying-ed object 10 prepared in the periphery of the outside pipe 2 A short paddle case, since melting of the fine particles by plasma flame is not fully performed, poor thermal spraying arises. For example, when thermal spraying was carried out on condition that the above, using an alumina as fine particles, the gray of gamma-alumina was presented, and only the coat of a striped pattern with the black circumference was obtained.
[0011] Although the thing which prevents such poor thermal spraying and also for which an outside pipe is lengthened as a cure (that is, distance L3 from the soffit of an induction coil 11 to the soffit of the outside pipe 2 is lengthened) is also considered, if the outside pipe 2 is not much long, in the soffit of a torch, sheath gas and plasma gas are intermingled, and cooling of the outside pipe by sheath gas is not fully performed, but an outside pipe is overheated, and it is not desirable. It is especially L3. If distance is set to 20mm or more, overheating of an outside pipe becomes excessive, for this reason, the oxygen of the outside pipe exterior and the boron nitride which is the quality of the material of an outside pipe will join together, sublimation will be begun, as a result, it will begin to collapse from the outer wall of an outside pipe, and the problem that a hole will open in the by pass outside ** at last will be caused.
[0012]
[Means for Solving the Problem] If this invention prepares the cooling pipe for cooling an outside pipe by coolant gas from a skin in the circumference of an outside pipe and considers as the plasma torch of four layer structures as a result of examination that the various troubles in the above-mentioned induction plasma torch should be canceled, even if it lengthens an outside pipe, it will prevent overheating of an outside pipe, will find out a bird clapper as always normal thermal spraying is possible, and will result in this invention.
[0013] namely, this invention -- a boron-nitride sintered compact -- becoming -- the interior -- multi-stage concentric circle-like insertion, while making the cylinder-like base material in which the hole was formed carry out fitting screwing of the carrier gas introduction pipe, the middle pipe, outside pipe, and cooling pipe made from a boron-nitride sintered compact one by one They are four layer structures which carried out fitting screwing of the gas supply pipe which introduces gas at the nose of cam of the middle pipe in the aforementioned base material, an outside pipe, and a cooling pipe to this pipe at a tangential direction. The position of the soffit of an outside pipe and a cooling pipe offers the induction plasma torch which is separated from the soffit of the induction coil prepared in the periphery of a cooling pipe 20mm or more.
[0014]
[Function] This invention by having arranged the cooling pipe in the circumference of an outside pipe, and having considered as the plasma torch of four layer structures of a carrier gas introduction pipe, a middle pipe, an outside pipe, and a cooling pipe An outside pipe can fully be cooled by supply of coolant gas from the skin at the time of thermal spraying. Distance L3 from an induction coil soffit to the soffit of an outside pipe and a cooling pipe when a long outside pipe is taken by this A normal plasma metal spray can be performed without causing the situation where thermal spraying is poor, even when referred to as 20mm or more.
[0015]
[Example] Hereafter, drawing 1 which shows the one example explains this invention in detail. In addition, since it is the same operation, those explanation is abbreviated to the term of a Prior art having explained the part which attached the same sign as drawing 2 in drawing 1 with reference to drawing 2 .
[0016] In drawing 1 , 13 is the cooling pipe prepared in the circumference of the outside pipe 2. this cooling pipe 13 is the thing of ** length mostly with the outside pipe 2 in the shape of a cylindrical shape made using the boron-nitride sintered compact, and the screw of a small pitch cuts it on the nose-of-cam periphery -- having -- **** -- the position of the maximum outside of a base material 1 -- insertion -- a hole -- the insertion formed 1a and in the shape of a concentric circle -- a hole -- the screw 14 of the small pitch cut at the nose of cam of 1j -- insertion -- a hole -- screwing fixation is carried out at 1
[0017] the supply pipe of the coolant gas supplied in order that 15 may cool the outside pipe 2 between a cooling pipe 13 and the outside pipe 2 -- it is -- this supply pipe 15 -- the insertion for cooling pipe 13 support -- a hole -- the insertion which was the same as the bore of a cooling pipe 13 above 1j, or was formed a little in the minor diameter -- a hole -- it is screwed on 1k by the tangential direction 1m -- a this screwing sake -- insertion -- a hole -- it is the screw of the small pitch currently cut by 1k
[0018] in addition, the above-mentioned insertion -- for forming Holes 1j and 1k in a base material -- insertion -- a hole -- 1j -- the insertion for outside pipe 2 insertion -- a hole -- formation of 1c -- subsequently -- carrying out -- ****ing -- insertion -- a hole -- formation of 1k -- insertion -- a hole -- what is necessary is just to carry out after formation of 1e
[0019] The induction plasma torch of this invention obtained in this way Each pipe of a cooling pipe 13, the outside pipe 2, the middle pipe 3, and the carrier gas introduction pipe 4 is manufactured from a boron-nitride sintered compact. each insertion in which these were formed to the interior of the cylinder-like base material 1 which consists of a boron-nitride sintered compact -- by having prepared in the hole in the shape of a concentric circle, and having lengthened the outside pipe and the cooling pipe enough Plasma gas, such as argon gas, is supplied by part for 5l./between the carrier gas introduction pipe 4 and the middle pipe

3 from the plasma-gas supply pipe 5. Sheath gas, such as argon gas, between the middle pipe 3 and the outside pipe 2 from the sheath gas supply pipe 6 by part for 20l./ Moreover, coolant gas, such as argon gas, is supplied to a cooling pipe 13 by part for 20l./from the coolant-gas supply pipe 15, respectively. If it carries out for carrying out and a RF (5kW and 13.56MHz) is impressed to an induction coil so that alumina fine particles with a particle size of 5-50 micrometers may be supplied by 1g/with carrier gas from the carrier gas introduction pipe 4 The normal plasma flame 12 which maintained balance well right and left was able to occur, and melting was carried out completely, and on the thermal-spraying-ed object 10, alumina fine particles were uniform, were excellent in heat conductivity and insulation, and were able to form the high coat of a withstand voltage.
[0020] It sets above and is the distance L3 from the soffit of an induction coil 11 to those soffits about the outside pipe 2 and a cooling pipe 13. It considers as the length used as 30mm. Distance L1 from the soffit of an induction coil 11 to the thermal-spraying-ed object 10 When referred to as 75mm, a uniform white alumina film is formed in a thermal-spraying-ed lifter, and it is L1. Although it was gray when referred to as 55mm, the alumina film without a striped pattern was formed.
[0021] By this invention, it is the distance L3 from the soffit of an induction coil to an outside jurisdiction edge as mentioned above. Since an outside pipe is enough cooled by coolant gas from the skin even if the field where it lengthens with 20mm or more (preferably 20-40mm), and sheath gas and plasma gas are intermingled is generated, there is no fear of becoming hot excessively. For this reason, there is no possibility [like] that the boron nitride which constitutes an outside pipe may combine with external oxygen, may sublimate, and an outside pipe may be damaged.
[0022]
[Effect of the Invention] As explained above, the induction plasma torch of this invention Since used the boron-nitride sintered compact for all members, and it was constituted by fitting screwing in the shape of a concentric circle, and the cooling pipe was arranged in the circumference of an outside pipe and it considered as four layer structures While enabling generating of the plasma flame which maintained balance right and left at the time of use, by arrangement of a cooling pipe, an outside pipe can be lengthened and melting of efficient fine particles and thermal spraying can be performed.
[0023] moreover, that the member of the same size is so much [easily and] producible since all members can be obtained by cutting of a boron-nitride sintered compact and each insertion which formed each part material in the cylinder-like base material further -- it has the great effect that it can design and manufacture with a sufficient precision to a hole at the shape of a concentric circle since fitting screwing is carried out In addition, since the screw is turned off, respectively even if the force joins this induction plasma torch from the exterior and a cooling pipe, an outside pipe, etc. are damaged, exchange is also easy.

[Translation done.]

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ABSTRACT:

PURPOSE: To execute homogeneous thermal spraying without external influence by generating horizontally balanced plasma flame in melting and thermally spraying powder on an induction plasma torch.

CONSTITUTION: A carrier gas introduction tube 4 made of a boron nitride sintered body, an intermediate tube 3, an outer tube 2, and a cooling tube 13 are successively and concentrically engaged with and threadably attached to a cylindrical support 1 in which multistage-concentrical inserting holes 1a-1e,

and 1j, 1k made by a boron nitride sintered body as a raw material are formed in the cylindrical support.

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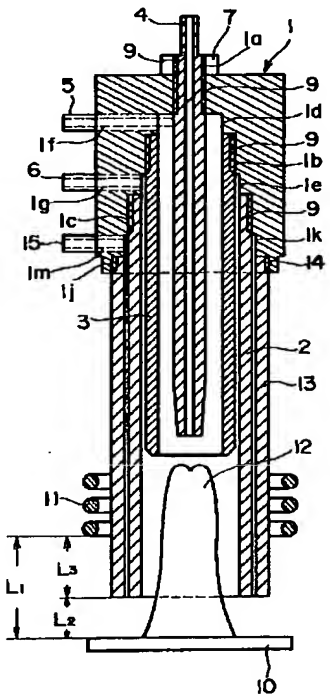
(54)【発明の名称】　インダクションプラズマトーチ

(57)【要約】
【目的】　インダクションプラズマトーチによる粉体の溶融、溶射に当たって、左右にバランスのとれたプラズマ炎を発生させるとともに、外部からの影響を受けることなく均質な溶射を行なう。
【構成】　窒化ほう素焼結体を素材として内部に多段の同心円状挿着孔１ａ乃至１ｅと１ｊおよび１ｋを形成した円筒状支持体１に窒化ほう素焼結体を用いて作ったキャリアガス導入管４、中間管３、外側管２、冷却管１３を順次同心円状に嵌合螺着させる。



1

【特許請求の範囲】

【請求項1】　窒化ほう素焼結体よりなり、内部に多段の同心円状挿着孔を形成した円筒状支持体に、窒化ほう素焼結体製のキャリアガス導入管、中間管、外側管および冷却管を順次嵌合螺着させるとともに、前記支持体内の中間管、外側管および冷却管の先端に該管に対して接線方向にガスを導入するガス供給管を嵌合螺着したことを特徴とする四層構造のインダクションプラズマトーチ。

【請求項2】　外側管および冷却管の下端の位置が冷却管の外周に設けた誘導コイルの下端から２０㎜以上離れていることを特徴とする請求項1記載の四層構造のインダクションプラズマトーチ。

【発明の詳細な説明】

【０００１】

【産業上の利用分野】この発明は、誘導結合型プラズマ内でセラミックスや金属等の粉体を効率よく加熱し、溶解して噴射でき、主として溶射に使用されるインダクションプラズマトーチに関するものである。

【０００２】

【従来の技術】従来、インダクションプラズマトーチとしては、透明石英で形成された外側管、中間管、キャリアガス導入管からなる三重構造のトーチに水冷誘導コイルを設けたものが多く用いられている。本来、インダクションプラズマトーチを用いて被溶射物上に満足できる溶融皮膜を形成させるためには、プラズマ炎を完全に左右にバランスよく発生させて、供給される粉体を完全溶融させることが必要であり、このためにはトーチの構成において前記各管が完全に同心円状に形成されていることが必要である。

【０００３】しかしながら、石英製の外側管、中間管、キャリアガス導入管の各管を用いて完全に同心円状のトーチを構成することは非常に難しいとされている。

【０００４】本発明者らはこのような状況に鑑みて、さきに窒化ほう素の焼結体を素材として用いた完全に同心円状のインダクションプラズマトーチを提案した。即ち、窒化ほう素焼結体よりなり、内部に多段の同心円状挿着孔を形成した円筒状支持体に、窒化ほう素焼結体製のキャリアガス導入管、中間管および外側管を順次嵌合螺着させるとともに、前記支持体内の中間管と外側管の先端に該管に対して接線方向にガスを導入するガス供給管を嵌合螺着した構造のインダクションプラズマトーチである。

【０００５】このトーチの構成を図２の縦断面図で説明すると、図において１は窒化ほう素焼結体を加工して得た円筒形状の支持体である。この支持体１の内部には１ａ～１ｅの多段の挿着孔が支持体１を旋盤等にて孔加工、ネジ切りを繰返すことにより同心円状に設けられており、これらの挿着孔にキャリアガス導入管４、中間管３、外側管２が嵌合螺着により固定されている。

2

【０００６】この円筒状支持体１に対する挿着孔の形成は、まず、キャリアガス導入管４を貫通挿着するための挿着孔１ａを支持体１に貫通形成し、次に中間管３の挿着孔１ｂを支持体１のほぼ中間の位置に挿着孔１ａと同心円状に形成し、その後外側管２の挿着孔１ｃを形成する。次いで中間管３支持用挿着孔１ｂの上方に中間管３の内径と同じか又は若干小径の挿着孔１ｄを、また外側管２支持用挿着孔１ｃの上方に外側管２の内径と同じか又は若干小径の挿着孔１ｅを形成する。

【０００７】このようにして内部に同心円状の１ａ～１ｅを形成した窒化ほう素焼結体製の円筒状支持体１に、同じく窒化ほう素焼結体を用いて夫々円筒形状に作った外側管２、中間管３、キャリアガス導入管４およびプラズマガス供給管５、シースガス供給管６を取り付けるには、まず挿着孔１ａに下方からキャリアガス導入管４を貫通させ、ネジ９で螺着固定する。その後同様にして挿着孔１ｂに中間管３を、挿着孔１ｃに外側管２を順次螺着し、次いでプラズマガス供給管５、シースガス導入管６を夫々挿着孔１ｄ、１ｅに接線方向に設けたネジ部１ｆ、１ｇに挿着し螺着する。なお、外側管２の内周面と中間管３の外周面との間は供給するガスの速度を増して冷却効率を高めるため約１㎜の小間隙となっている。

【０００８】このようにして窒化ほう素焼結体を用いて同心円状に構成したインダクションプラズマトーチを用い、プラズマガス供給管５からキャリアガス導入管４と中間管３との間にアルゴンガスなどのプラズマガスを５リッター／分で供給し、シースガス供給路６から中間管３と外側管２との間にアルゴンガスなどのシースガスを２０リッター／分で供給し、キャリアガス導入管４からキャリアガスとともに粒径５～１００μmの粉体を１ｇ／分供給する状態で誘導コイル１１に５KW、１３．５６MHzの高周波を印加すると、左右によくバランスのとれた正常なプラズマ炎１２が発生して粉体が溶融され、被溶射物１０上に皮膜が形成される。

【０００９】

【発明が解決しようとする課題】しかしながら、このように窒化ほう素焼結体を素材として用いて完全に同心円状構造に製造したインダクションプラズマトーチによって溶融粉体の溶射を行なったとしても、誘導コイル１１の下端から外側管２の下端までの距離L_3があまり短いと、粉体のプラズマ炎による溶融、溶射時にプラズマトーチ外部からの低温空気による冷却凝固や酸化反応が生じ、被溶射物１０に対する溶射不良を生ずるおそれがある。

【００１０】また、外側管２の外周に設けた誘導コイル１１の下端から被溶射物１０までの距離L_1が短かい場合、プラズマ炎による粉体の溶融が充分に行なわれないために溶射不良が生ずる。例えば、粉体としてアルミナを用いて上記の条件で溶射した場合にはγ－アルミナの灰色を呈し、周囲が黒色の縞模様の皮膜しか得られなか

った。

【0011】このような溶射不良を防止する対策として、外側管を長くする（即ち、誘導コイル11の下端から外側管2の下端までの距離L_3を長くする）ことも考えられるが、外側管2があまり長いと、トーチの下端ではシースガスとプラズマガスとが混在してしまってシースガスによる外側管の冷却が十分に行なわれず、外側管が過熱されて好ましくない。特にL_3の距離が20㎜以上になると、外側管の過熱が甚だしくなり、このため外側管外部の酸素と外側管の材質である窒化ほう素とが結合して昇華をはじめ、その結果外側管の外壁から崩れだして、遂には外側管に穴があいてしまうという問題を引き起こす。

【0012】

【課題を解決するための手段】この発明は上記したインダクションプラズマトーチにおける種々の問題点を解消すべく検討の結果、外側管を外壁面から冷却ガスによって冷却するための冷却管を外側管の周囲に設けて四層構造のプラズマトーチとするならば、外側管をたとえ長くしても外側管の過熱を防止して常に正常な溶射が可能となることを見出し、この発明に至ったものである。

【0013】即ち、この発明は窒化ほう素焼結体よりなり、内部に多段の同心円状挿着孔を形成した円筒状支持体に、窒化ほう素焼結体製のキャリアガス導入管、中間管、外側管および冷却管を順次嵌合螺着させるとともに、前記支持体内の中間管、外側管および冷却管の先端に該管に対して接線方向にガスを導入するガス供給管を嵌合螺着させた四層構造であって、外側管および冷却管の下端の位置が冷却管の外周に設けた誘導コイルの下端から20㎜以上離れているインダクションプラズマトーチを提供するものである。

【0014】

【作用】この発明は、外側管の周囲に冷却管を配設してキャリアガス導入管、中間管、外側管および冷却管の四層構造のプラズマトーチとしたことによって、溶射時に外側管をその外壁面から冷却ガスの供給によって十分に冷却することができ、これによって外側管を長くとった場合、即ち、誘導コイル下端から外側管および冷却管の下端までの距離L_3を20㎜以上とした場合でも溶射不良の事態を招くことなく正常なプラズマ溶射を行なうことができる。

【0015】

【実施例】以下、この発明をその一実施例を示す図1により詳細に説明する。なお、図1において図2と同一の符号を付した部位は図2を参照して従来の技術の項で説明したと同じ作用であるのでそれらの説明は省略する。

【0016】図1において、13は外側管2の周囲に設けた冷却管である。この冷却管13は窒化ほう素焼結体を用いて作った円筒形状で外側管2とほぼ同長のものであり、その先端外周に小さなピッチのネジが切られてお

り、支持体1の最外側の位置に挿着孔1aと同心円状に形成した挿着孔1jの先端に切られた小さいピッチのネジ14とによって挿着孔1jに螺着固定されている。

【0017】15は冷却管13と外側管2の間に外側管2を冷却するために供給される冷却ガスの供給管であって、この供給管15は冷却管13支持用挿着孔1jの上方に冷却管13の内径と同じか又は若干小径にて形成された挿着孔1kにその接線方向に螺着されている。1mは、この螺着のために挿着孔1kに切られている小さいピッチのネジである。

【0018】なお、上記した挿着孔1jおよび1kを支持体内に形成するには、挿着孔1jは外側管2挿着用の挿着孔1cの形成について行えばよく、挿着孔1kの形成は挿着孔1eの形成後に行えばよい。

【0019】かくして得られたこの発明のインダクションプラズマトーチは、冷却管13、外側管2、中間管3およびキャリアガス導入管4の各管を窒化ほう素焼結体より製造し、これらを窒化ほう素焼結体よりなる円筒状支持体1の内部に形成した各挿着孔に同心円状に設け、かつ外側管および冷却管を十分長くしたことによって、プラズマガス供給管5からキャリアガス導入管4と中間管3との間にアルゴンガスなどのプラズマガスを5リッター／分で供給し、シースガス供給管6から中間管3と外側管2との間にアルゴンガスなどのシースガスを20リッター／分で、また冷却ガス供給管15から冷却管13にアルゴンガスなどの冷却ガスを20リッター／分で夫々供給し、キャリアガス導入管4からキャリアガスとともに例えば粒径5～50μmのアルミナ粉体を1g／分供給するようにして誘導コイルに5KW、13．56MHzの高周波を印加すると、左右によくバランスのとれた正常なプラズマ炎12が発生してアルミナ粉体が完全に溶融され、被溶射物10上に均一で熱導電性、絶縁性にすぐれ、耐電圧の高い皮膜を形成することができた。

【0020】上記において、外側管2および冷却管13を誘導コイル11の下端からそれらの下端までの距離L_3が30㎜となる長さとし、誘導コイル11の下端から被溶射物10までの距離L_1を75㎜とした場合には被溶射物上に均一な白色のアルミナ皮膜が形成され、またL_1を55㎜とした場合においては灰色ではあるが縞模様のないアルミナ皮膜が形成された。

【0021】この発明では上記のように誘導コイルの下端から外側管下端までの距離L_3を20㎜以上（好ましくは20～40㎜）と長くしてシースガスとプラズマガスが混在する領域が生じても、外側管はその外壁面から冷却ガスによって十分冷却されるため、過大に熱せられるという心配はない。このため外側管を構成する窒化ほう素が外部の酸素と結合して昇華したりして外側管が損傷するようなおそれは全くない。

【0022】

5

【発明の効果】以上説明したように、この発明のインダクションプラズマトーチは、全ての部材に窒化ほう素焼結体を用いて同心円状に嵌合螺着により構成され、かつ外側管の周囲に冷却管を配設して四層構造としたので、使用時に左右にバランスのとれたプラズマ炎の発生を可能とするとともに冷却管の配設により、外側管を長くして効率のよい粉体の溶融、溶射を行なうことができる。

【００２３】また、全ての部材を窒化ほう素焼結体の切削加工によって得ることができるので、同一寸法の部材を容易にかつ多量に生産できること、さらに各部材は円筒状支持体内に形成した各挿着孔に同心円状に嵌合螺着するので精度よく設計、製造することができるという多大の効果を有するのである。なお、このインダクションプラズマトーチに外部から力が加わり、冷却管、外側管などが破損しても、それぞれネジが切られているので交換も容易である。

【図面の簡単な説明】

【図１】この発明のインダクションプラズマトーチの縦

6

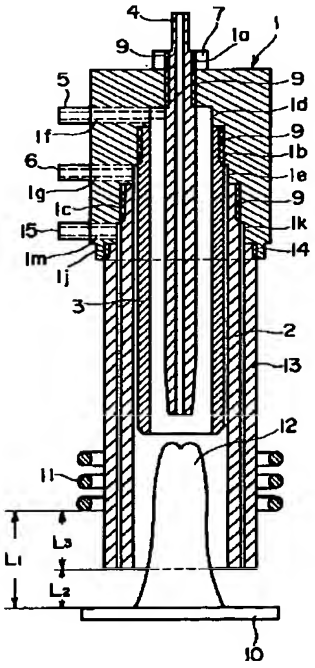
断面図である。

【図２】従来のインダクションプラズマトーチの縦断面図である。

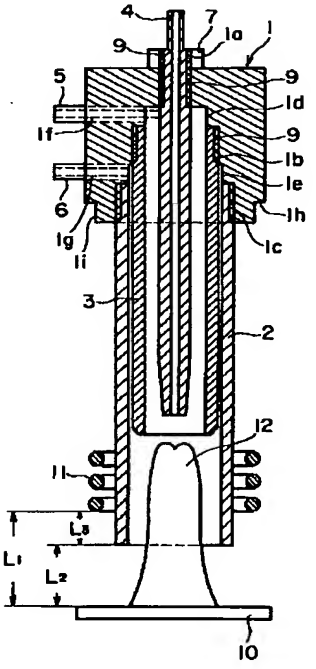
【符号の説明】

１　円筒状支持体
１ａ　挿着孔
１ｂ　挿着孔
１ｃ　挿着孔
１ｊ　挿着孔
２　外側管
３　中間管
４　キャリアガス導入管
９　ネジ
１１　誘導コイル
１２　プラズマ炎
１３　冷却管
１４　ネジ

【図１】



【図２】



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